

13.8V REGULATED POWER SUPPLY

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In these days of "black box" operation, it can be refreshing and rewarding to actually build something that works, especially when the cost is minimal. After all, most amateurs seek the "best" at the lowest possible cost. The power supply to be described has a regulated output of 13.8 volts DC adjustable, with a maximum load of around 10 amps. This is more than enough to drive the average 2 metre FM unit with an output of 25 watts.

GENERAL DESCRIPTION

The actual layout and construction details will be left to the constructor as they are not critical. The heart of any power supply is the transformer and this can be quite a costly item. In this case the transformer is one recovered from an old B & W television set, many of which are resting as junk in sheds or even obtainable from the local "tip". The transformer is partly rewound by stripping away the original secondary winding and replacing with a heavy duty 18 volt winding. This operation, whilst time consuming, is interesting and certainly not difficult.

The 18 volt winding is fed into a conventional bridge rectifier unit and the DC output is then controlled by a UA78HG regulator which controls a bank of 2N3055 transistors. These of course, must be mounted on a heavy heat sink. This can be either a commercial type sink or a very heavy piece of aluminium or copper "U" section material. This sink is best mounted on the outside of the case to allow better heat dissipation.

Components these days are most reliable. However, should one of the regulating transistors develop a "short circuit" then the output voltage would instantly rise to a dangerous level, causing damage to valuable equipment. Most 12 volt units can only stand a maximum of 15 volts before damage occurs. It is desirable therefore that there be some form of protection against high voltage. Many power supplies have the popular "crowbar" protection, in which, when the voltage exceeds a set value, a Zener diode conducts and "fires" a SCR which in turn short circuits the output and blows a fuse.

In this supply, the cost of protection has been cut by fitting a 15V Zener diode across the output. In the event of the voltage rising above 15 volts, the Zener diode will conduct and "short" the output thus protecting the equipment. The current carried by the Zener diode is far in excess of its rated current and therefore the diode is destroyed. When the Zener diode is

destroyed, it invariably becomes short circuit and the DC fuse will be blown thus completely isolating the equipment. The only cost for repair would be the faulty regulating transistor and a Zener diode. However, this is a remote risk and may never happen. It is re-assuring to know, nevertheless, that there is some form of over-voltage protection for valuable equipment.

CONSTRUCTION DETAILS — TRANSFORMER

The TV power transformer should be carefully examined for any damage. It should be removed from the chassis noting and marking the 240, 220, 210 volt primary input winding connections. The secondary heater winding is usually 6.3 or 12.6 volts. This winding is obvious because it is wound with heavy gauge wire. After removal, connect the primary to the 240 volt mains supply and check the secondary heater winding with a multimeter (AC volts) to ascertain if it is 6.3 or 12.6. After checking, carefully tie back the primary connections to avoid breaking the wires. The transformer should now be dismantled by firstly removing the four bolts holding the laminations and frame together. After removal of frame and clamps the first lamination should be removed. This is the most difficult part of the entire project as these are usually pressed in by machine and difficult to remove. A thin bladed screwdriver driven in between laminations can frequently enable one lamination to be gripped by long nosed pliers and removed. The laminations are usually in an "E" and "I" shape configuration and should be completely removed and stacked.

The heater winding is on the outside, and should now be carefully unwound making sure to **count the turns as they are removed**. When this winding has been removed and the number of turns noted, the remaining secondary winding can be stripped either by unwinding or **careful** use of a hacksaw remembering that the primary winding underneath is to be re-used. Some

transformers from Astor and AWA sets have a double bobbin winding with primary on one side and secondary on the other. These are particularly easy to rewind. The more usual type have the primary against the core, then the high voltage secondary and finally the heater winding on the outside.

Having stripped the bobbin down to its basic primary winding, the turns ratio of the transformer must be calculated. The "turns per volt" figure is found by dividing the turns counted by the heater winding voltage. This is nominally 6.3 or 12.6 volts. However most manufacturers wind transformers for 6.5 or 13 volts to allow for a voltage drop. It is common to find that the 12.6 volt winding has 39 turns. The "turns per volt" figure would be

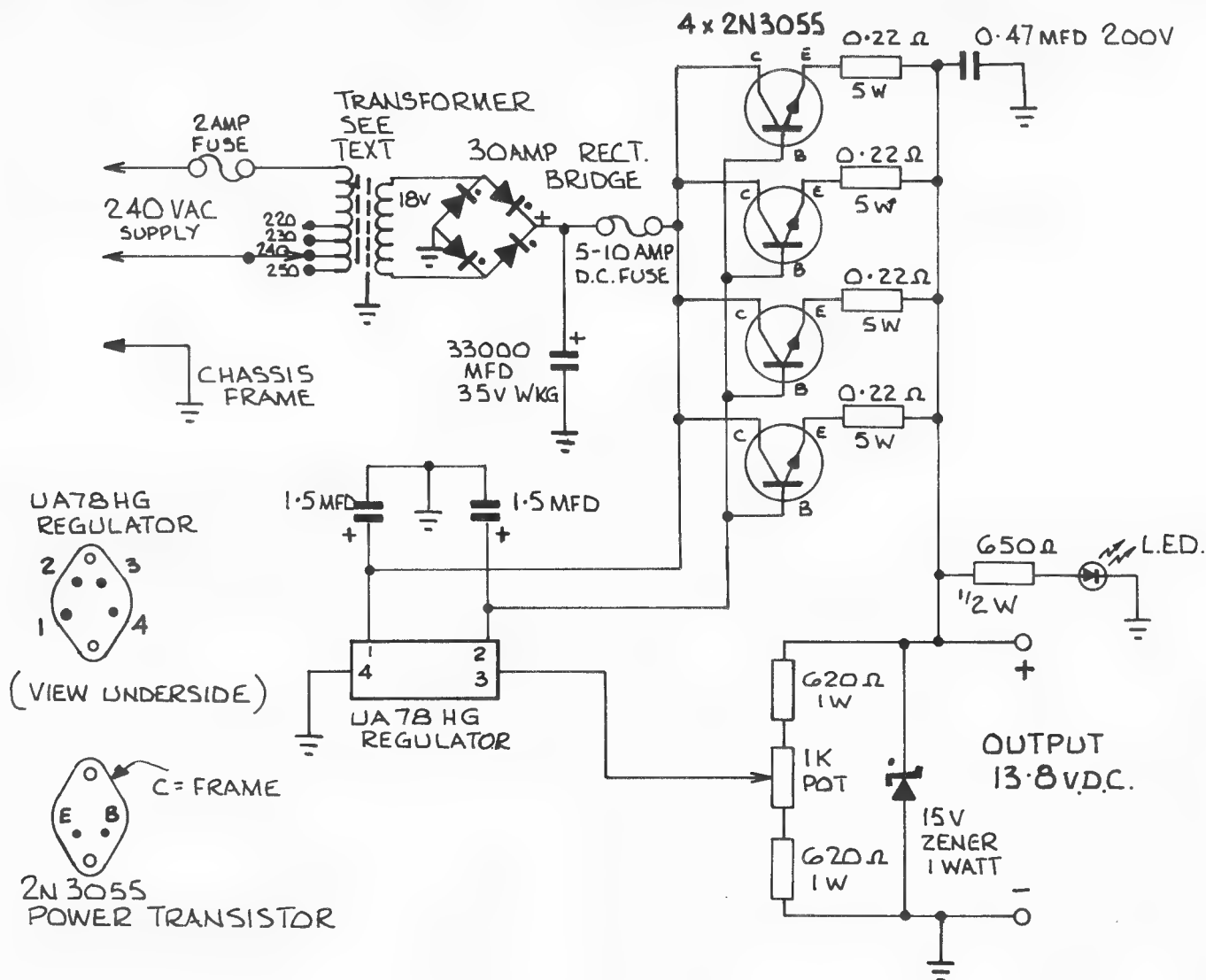
$$\frac{39}{13} = 3$$

This means we need 3 turns on the secondary for each volt of secondary output. In our case we need 18 volts, therefore we would need $3 \times 18 = 54$ turns. This is only an example and you must calculate for your particular transformer to obtain 18 volts output.

To rewind the secondary we need wire that will supply 10 amps without overheating, 14 Gauge B & S is adequate and can be purchased from retailers or automotive electricians. A length of 10 metres should be enough for an average transformer. The winding is wound on carefully layer by layer, although it can be "jumble" wound if there is enough space.

The turns must be carefully counted on and when the winding is complete a layer of PVC tape should be wound around it. The ends should be covered with spaghetti and extended out in a similar way to the original heater winding. Now the core must be replaced by fitting the laminations back into the bobbin. If the laminations are the "E & I" type, it is easier to fit 3 "E" sections at a time alternating the direction. The "I" pieces can be fitted later.

It is part of "Murphy's Law" that all the laminations removed will never be re-



Power Supply 13.8 V Regulated

placed, so do your best. The last few will be difficult to fit and careful use of a **small** hammer will assist. The assembly should be tapped into square shape with the hammer and the 4 bolts and mounting plates fitted. When finally together and looking like original, connect 240 AC to the primary and check the secondary voltage. If your calculations have been correct and all care taken your meter will read 18 volts. If your reading is not exactly 18 volts, you can adjust by changing the primary tapping. By connecting 240 volt mains to the 250 volt tapping, the output will be dropped and similarly connecting to the 230 volt tapping will increase the output.

CONSTRUCTION — GENERAL

The general assembly of the power supply will be left to the constructor. The transformer should be well mounted and all bolts tightened to prevent "buzz". The regulator can be mounted in any position and does not require any heat sink. It can be mounted on a small piece of aluminium

formed into a bracket. It is important that the 1.5 µF bypass capacitors be mounted directly on the regulator itself and **not** wired away. The output fuse should be rated only marginally higher than the maximum load expected. To operate a set such as the IC22S a fuse rating of 5 amps would be adequate. The main filter capacitor, shown as 33,000 µF, is from a disposal computer power supply.

Any value larger than 25,000 µF would be acceptable and this could be made up from several smaller capacitors wired in parallel. An example could be 5 capacitors, each of 5000 µF, wired in parallel. Be sure the voltage rating is adequate. Any rating higher than 30 volts working is sufficient.

After completion of wiring and circuit check, set the voltage adjustment potentiometer to the "low" end (earthy side). This will protect the Zener diode in the event that the output voltage is in excess of 15 volts. Connect an accurate voltmeter or multimeter to the output and switch on AC supply. Carefully adjust the potentiometer

until 13.8 volts is noted. The LED should be glowing. When satisfied that all is well, connect transceiver and check with another station for any noise or hum. The supply is clean and hum is not discernible. Check the voltage reading when the transmitter is operated. The drop should be barely noticeable. With the values shown and a transformer of the TV type, an output of 10 amperes, well regulated, will be available and there will not be too big a dent in your domestic budget.

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